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**Proceedings of the zonal peer review meeting of a current assessment of Northern, Spotted, and Atlantic Wolffish related to population status, life history, and habitat**

**January 23-24, 2013**

**St. John's, NL**

**Chairperson: Geoff Veinott**

**Editors: Lee Sheppard and Erika Parrill**

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## Foreword

The purpose of these Proceedings is to document the activities and key discussions of the meeting. The Proceedings may include research recommendations, uncertainties, and the rationale for decisions made during the meeting. Proceedings may also document when data, analyses or interpretations were reviewed and rejected on scientific grounds, including the reason(s) for rejection. As such, interpretations and opinions presented in this report individually may be factually incorrect or misleading, but are included to record as faithfully as possible what was considered at the meeting. No statements are to be taken as reflecting the conclusions of the meeting unless they are clearly identified as such. Moreover, further review may result in a change of conclusions where additional information was identified as relevant to the topics being considered, but not available in the timeframe of the meeting. In the rare case when there are formal dissenting views, these are also archived as Annexes to the Proceedings.

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## SUMMARY

An assessment of Northern, Spotted, and Atlantic Wolffish was held at the Holiday Inn in St. John's, Newfoundland and Labrador, on January 23-24, 2013. All three species of wolffish were previously listed on Schedule 1 of the *Species at Risk Act* (SARA) as being either threatened (Northern and Spotted Wolffish) or of special concern (Atlantic Wolffish), due to significant declines in relative abundance indices and reductions in area occupied during the 1980s and early 1990s. In September 2010, a zonal pre-COSEWIC (Committee on the Status of Wildlife in Canada) assessment of Atlantic, Northern, and Spotted Wolffish was held to peer-review Fisheries and Oceans Canada (DFO) information relevant to the COSEWIC status assessment for the three wolffish species in Canadian waters. The current Zonal Advisory Process (ZAP) meeting provided an update on wolffish life history, population status, and habitat requirements summarizing research completed and data collected from September 2010 to present. This information was used in the development of the five-year report (2008-2013) on recovery progress and implementation for Northern Wolffish and Spotted Wolffish.

Participants at the meeting included representatives from DFO Science, Species at Risk, and Fisheries Management, Newfoundland and Labrador Department of Fisheries and Aquaculture, Memorial University, fishing industry, and members of COSEWIC/Marine Fishes Subcommittee.

In addition to these proceedings, publications to come from the meeting include a Science Advisory Report and comprehensive Research Documents, all to be available online on the [DFO Canadian Science Advisory Secretariat Website](#).



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**Compte rendu de la réunion d'examen zonal par les pairs sur l'évaluation actuelle du loup à tête large, du loup tacheté et du loup atlantique en ce qui concerne l'état des populations, le cycle biologique et l'habitat**

**SOMMAIRE**

Une évaluation du loup à tête large, du loup tacheté et du loup atlantique a été menée au Holiday Inn de St. John's (Terre-Neuve-et-Labrador) les 23 et 24 janvier 2013. Les noms des trois espèces de loup de mer figuraient précédemment à l'annexe 1 de la *Loi sur les espèces en péril* (LEP) à titre d'espèce menacée (loup à tête large et loup tacheté) ou d'espèce préoccupante (loup atlantique), en raison des diminutions importantes des indices d'abondance relatifs et des réductions de l'occupation des zones habitées dans les années 1980 et au début des années 1990. En septembre 2010, une évaluation zonale préalable à celle du COSEPAC (Comité sur la situation des espèces en péril au Canada) du loup à tête large, du loup tacheté et du loup atlantique a été menée pour procéder à un examen par les pairs des renseignements de Pêches et Océans Canada (MPO) en ce qui concerne l'évaluation de la situation du COSEPAC pour les trois espèces de loup de mer présentes dans les eaux canadiennes. La réunion sur le processus d'évaluation zonale (PEZ) actuel présentera une mise à jour sur le cycle biologique, l'état de la population et les exigences en matière d'habitat du loup de mer résumant les recherches effectuées et les données recueillies de septembre 2010 jusqu'à présent. Ces renseignements ont été utilisés dans le cadre de l'élaboration du rapport quinquennal (2008-2013) sur les progrès de la mise en œuvre du rétablissement du loup à tête large et du loup tacheté.

Parmi les participants à la réunion, on retrouve les représentants du secteur des Sciences du MPO, des espèces en péril, de la gestion des pêches, du ministère des Pêches et de l'Aquaculture de Terre-Neuve-et-Labrador, de l'Université Memorial et de l'industrie des pêches, de même que les membres du sous-comité du COSEPAC et du sous-comité des poissons marins.

En plus du présent compte rendu, des publications au sujet de la réunion seront publiées, y compris un avis scientifique et des documents de recherche exhaustifs, qui seront toutes disponibles en ligne sur le site Web du Secrétariat canadien de consultation scientifique du ministère des Pêches et des Océans.

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## INTRODUCTION

The recovery strategy for Northern Wolffish (*Anarhichas denticulatus*) and Spotted Wolffish (*Anarhichas minor*), and management plan for Atlantic Wolffish (*Anarhichas lupus*) in Canada (Kulka et al. 2007) was published on the *Species at Risk Act* (SARA) public registry in February 2008. The SARA s.46 states that “the competent Minister must report on the implementation of the recovery strategy and the progress towards meeting its objectives, within five years after it is included in the public registry and in every subsequent five-year period, until its objectives have been achieved or the species’ recovery is no longer feasible. The report must be included in the public registry.” Similarly, s.72 of the Act states that “the competent Minister must monitor the implementation of the management plan and must assess its implementation five years after the plan is included in the public registry, and in every subsequent five-year period, until its objectives have been achieved. The report must be included in the public registry.” The Newfoundland and Labrador Region Species at Risk Program was responsible for delivery of the five-year report in February 2013. In September 2010, a zonal pre-COSEWIC assessment of Atlantic, Northern, and Spotted Wolffish was held to peer-review DFO information relevant to the COSEWIC status assessment for the three wolffish species in Canadian waters (DFO 2011). A ZAP meeting was held on January 23-24, 2013 in St. John’s, NL, to provide an update on wolffish life history, population status, and habitat requirements summarizing research completed and data collected from September 2010 to present. This information was used in the development of the five-year report (2008-13) on recovery progress and implementation for Northern Wolffish and Spotted Wolffish.

Participants were welcomed by the Chair and provided with an overview of the Canadian Science Advisory Secretariat (CSAS) Science Advisory Process and the background on the SARA and the pre-COSEWIC process. The main purpose of the ZAP was to peer-review DFO information relevant to the COSEWIC status assessment for Northern and Spotted Wolffish. After a roundtable introduction of participants (Appendix 3), the Chair reviewed the Terms of Reference (TOR; Appendix 1) and the meeting agenda (Appendix 2).

## MEETING PROCEEDINGS

### UPDATE OF WOLFFISH SURVEY VESSEL DATA

*Presenter: Mark Simpson, DFO Science, NL Region*

#### Abstract

The most recent information on trends in abundance and distribution of *Anarhichus denticulatus* (Northern Wolffish), *A. minor* (Spotted Wolffish), and *A. lupus* (Atlantic Wolffish) was presented for Northwest Atlantic waters adjacent to Newfoundland and Labrador. All three species of wolffish were previously listed on Schedule 1 of SARA as being either threatened (*A. denticulatus*, *A. minor*) or of special concern (*A. lupus*), due to significant declines in relative abundance indices and reductions in area occupied during the 1980s and early 1990s. Their SARA statuses were upheld by COSEWIC in November 2012. However, some signs of population recovery were recently detected: primarily, indices of relative abundance and distribution for these species tended to increase in most areas surveyed during the last decade.

All three wolffish species continue to reach their highest densities and cover their largest areas on the northeast Newfoundland and southern Labrador shelves. An area north of the Grand Banks represents the most persistent concentrations of Northern Wolffish and Spotted Wolffish in the Northwest Atlantic; while an area of persistent concentration for Atlantic Wolffish is the

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southern Grand Banks. Recent catch rates, in both fall and spring surveys, continue to show generally stable or very gradually increasing trends. Similarly, the indices for area of occupancy were stable or increased slightly as the distribution of wolffish expanded.

In the DFO's Precautionary Approach (PA) framework, the critical, cautious, and healthy stock status zones are defined by the Limit Reference Point (LRP) and an Upper Stock Reference Point (USR). For illustrative purposes, an empirical Bmsy proxy was derived from the DFO fall research vessel (RV) survey time series (1978-2011) in Northwest Atlantic Fisheries Organization (NAFO) Div. 2J3KL; with which default PA reference points of 40 % Bmsy (LRP) and 80 % Bmsy (USR) were calculated. More specifically, the Bmsy proxy and associated empirically-derived reference points were derived from the geometric mean of a 10-year period chosen to reflect a period of high productivity from 1978 to 1988.

## Discussion

There was discussion amongst participants regarding acoustic tagging. The calculation of biological reference points was also briefly discussed. It was concluded that a biomass index is used for many species where no analytical model is available. The use of abundance indices using data from bottom trawl surveys and the indices' ability to eliminate depth sampling variability was touched on by participants. The consensus of the discussion was that the general analysis was adequate; however, time series should be adjusted to include data from both periods of high and low abundance.

## FEEDING HABITS AND TROPHIC NICHE DIFFERENTIATION IN THREE SPECIES OF WOLFFISH (*ANARHICHAS* SP.) INHABITING NEWFOUNDLAND AND LABRADOR

Presenter: Luiz Mello, DFO Science, NL Region

### Abstract

The food and feeding habits of Northern Wolffish (*Anarhichas denticulatus*), Spotted Wolffish (*A. minor*), and Atlantic Wolffish (*A. lupus*), coexisting in Newfoundland and Labrador continental shelf waters, were examined. A total of 1,451 stomachs were analyzed for contents: 152 for Northern Wolffish; 262 for Spotted Wolffish; and 1,037 for Atlantic Wolffish. No particular prey item dominated the diet of any species. The two most important prey groups for Northern Wolffish were pelagic fish and benthic fish (52 % of total fullness), shrimp and echinoderms (68 %) for Spotted Wolffish, and crabs and echinoderms (57 %) for Atlantic Wolffish. Diet overlap was highest between Spotted and Atlantic Wolffish (Schoener's Index;  $a = 0.52$ ), and lowest among Northern and Atlantic Wolffish ( $a = 0.21$ ). Ontogenetic shifts in diet proportions of nine major prey groups were described for each species. Discriminant function analysis correctly classified species based on mean feeding habits (partial fullness index (PFI)), with a 93-100 % success rate. Species differed significantly with respect to the relative proportions of nine major prey groups (mean PFI) in the diet (MANOVA;  $p < 0.0001$ ), and with regards to percent contribution of benthic and piscivorous prey (MANOVA;  $p < 0.01$ ). Based on all analyses, Northern Wolffish were described as "fish specialists" (piscivores), Spotted Wolffish as "echinoderm specialists" (benthivores), and Atlantic Wolffish as "mollusc specialists" (benthivores). It is recommended that consideration of these distinct trophic niche designations would be helpful to designing more effective strategies for wolffish population recovery, and also to managing their local sustainability at sites perturbed by oil and gas exploration/ production, bottom-contact fishing, marine transportation, mining, and hydroelectric projects.



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## Discussion

During the discussion, an argument was made that the presenter should have used an approach similar to the one used for calculating the length-adjusted condition factor. It was suggested that in the latter, the scaling coefficient was derived analytically from a length-weight power relationship. Furthermore, it was stated that the relationship can result in values slightly smaller than 3. It was recommended during the discussion that the same coefficient should be used in all calculations instead of using the default value of three. Participants also noted the possibility that time series may be possibly too short to provide evidence that the species' diet changed through time.

## WOLFFISH COMMERCIAL CATCH DATA

*Presenter: Carolyn Miri, DFO Science, NL Region*

### Abstract

Commercial fishery removals of three species of wolffish in the Northwest Atlantic were examined for the period 1960-2011, using commercial data available in four databases: NAFO STATLANT-21A unspciated wolffish catch data (1960-2011) reported by NAFO contracting parties/flag states fishing mainly outside Canada's 200-mile limit; DFO-NL ZIF (Zonal Interchange Format) unspciated wolffish landings data (1985-2011) reported by Canadian fishers operating in Canada's exclusive economic zone (EEZ); Canadian Fisheries Observers' speciated catch data (1978-2011) collected on a set-by-set basis at sea aboard commercial fishing vessels; and SARA logbooks (2004-12) completed by NL fishers aboard >35-foot commercial vessels in Canada's EEZ. A brief overview of each commercial database was given. With NAFO-reported data, total reported landings of unspciated wolffish were investigated by year and Subarea/Division. With ZIF data, total reported landings of unspciated wolffish were examined by year, Subarea/Division, wolffish bycatch/directed fisheries, and fishing gear type. With Observer data, total catches of each species of wolffish were studied by year and Subarea/Division. Canadian Fisheries Observers constitute the only reliable source of information on speciated commercial catches and discards at sea. Reported landings of wolffish have declined over the past ten years inside Canada's 200-mile limit. Commercial discarding and "live" release of wolffish sometimes occurs unreported. SARA logbooks of NL fishers indicated that Northern Wolffish and Atlantic Wolffish were most susceptible to commercial bycatch mortality in 2010-12; while Spotted Wolffish consistently showed a high percentage of survival before release to the ocean. However, live release of wolffish by fishers does not guarantee post-release survival.

### Discussion

It was concluded amongst participants that the observer system has changed over the years, as observers now work for a third party company. In 2013, their services will be contracted by industry as opposed to DFO. Fisheries Management (FM) is currently negotiating with industry on terms of coverage. Ongoing negotiations with Groundfish Enterprise Allocation Council (GEAC) regarding observer coverage details suggest that greater than 100 foot fleet will be subject to 100 % observer coverage. There is a target of 10-15 % for inshore, which may decline to as little as 2 %. Unreported discarding and live release of wolffish occurs inside and outside the Canadian EEZ. The only reliable source of speciated discard data, that from observers, may decline in 2013.

It was stated that with respect to NAFO data, most wolffish landings have been reported from Div. 3LNO, where there has been a significant decline since the period of 2002-2005. During



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this time, annual landings declined from an average of 540 t, to an average of about 160 t in 2008-11. In Subdiv. 3Ps, recorded landings averaged 42 t, and consisted mainly of Atlantic Wolffish, as the other two species were required to be discarded as of 2003. There were generally low landings from Div. 4RST. An annual average of 91 t was estimated to have been caught from Div. 4VWX until 2009, when a catch of 908 t was recorded, followed by two years of no catches.

It was suggested that the 2010-11 average of 129 t in Div. 3LNO appears incorrect, and as such, the data will be checked.

It was stated that according to the DFO's ZIF data, Canadian reported landings inside the EEZ, in Subareas 2 and 3, peaked in 1987 at 1,300 t, and declined to almost zero in the mid-1990s. In Div. 3P, landings averaged 226 t from 1998 to 2002, and declined significantly since, to negligible numbers since 2004. Landings for 2011 were the lowest ever reported.

It was determined that Canadian fishers in the EEZ have used trawls, gillnets and longlines to catch wolffish, though landings from all gears have been insignificant since 2004. The decline in trawl landings has been most significant. In Canadian fisheries, wolffish generally constitute bycatch and, since 2003, DFO has imposed mandatory live release of Northern and Spotted Wolffish because of their SARA listing, though this does not guarantee post-release survival.

It was suggested that data from fisheries inside Canada's EEZ, as collected by observers, reveals separate landings trends for all three wolffish species in Subareas 2 and 3. Northern Wolffish landings averaged 89 t from 1993 to 2005, but were negligible afterwards. Landings of Spotted Wolffish were insignificant after 1992, while landings of Atlantic Wolffish peaked during 2001-05, averaging 375 t, before declining to insignificant numbers.

It was stated that additional data on wolffish discards, and condition at time of release, comes from SARA logbooks, available from 2004 to present. These are maintained by Canadian fishers in the Canadian EEZ on vessels greater than 35 feet. Logbooks indicate that survival rates of Northern Wolffish improved over the time series but have been declining in recent years, as have those for Atlantic Wolffish, which have exceeded 80 % annually from 2004 to 2009. Reasons for these declines in survival are unknown. Survival rates of Spotted Wolffish have been good, in excess of 85 % annually.

It was concluded that there are a considerable number of factors to consider regarding the survival of Spotted Wolffish. The species does not possess an air bladder but are temperature sensitive fish, and hauling them through multiple temperature zones/warmer water and also from greater depths may present problems with survival. Gear, timing of fishery, temperature, and depth may all affect survival.

It was noted that the studies in question were conducted in spring, in shallow water with stratification present. The studies were also conducted in December, when no stratification was present. In all cases, even with 1.5 hours of air exposure, survival was stated to be good.

It was also discussed that when interpreting the data, it should be noted that commercial gear, with the exception of shrimp trawls, catch adults. Shrimp trawls catch young-of-the-year (YOY) wolffish, but exclude adults via implements such as the Nordmore grate.

It was suggested that at sea, identification/speciation of wolffish is straightforward. As such, it was recommended that mandatory speciation by NAFO contracting parties/flag states inside and outside EEZ be adopted. It was also suggested that mandatory speciation be made a licensing requirement by DFO, and thus applicable to all Canadian fishers operating within the Canadian EEZ.

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## **MORPHOMETRIC AND MERISTICS VARIABILITY OF WOLFFISH (*ANARHICHAS* SP.) IN NEWFOUNDLAND AND LABRADOR WATERS**

*Presenter: Luiz Mello, DFO Science, NL Region*

### **Abstract**

This study evaluates morphological and meristic variation within each of the three wolffish species found in Newfoundland and Labrador waters, and utilizes the observed patterns to provide a basis for delineating distinct groups of fish within the study area. A total of 1,425 specimens (136 Northern Wolffish, 244 Spotted Wolffish, and 1,045 Atlantic Wolffish) collected during DFO RV bottom-trawl surveys in Div. 2HJ3KLMNO and Subdiv. 3Ps were sampled for standard morphometric and meristic characteristics. Principal Component Analysis explained between 74-79 % and 84-88 % of the variance of the morphometric and meristic measurements, respectively. Bivariate plots of Principal Components were able to detect variation patterns of morphometric characteristics in Northern Wolffish, and of morphometric and meristic characteristics in Atlantic Wolffish specimens sampled in different areas.

Based on this analysis, it appears that Northern Wolffish comprises at least two distinct groups of fish within the NL region: a southern group centered in the northern and southeastern Grand Bank (Div. 3LN), and another smaller group scattered over much of the northeast Newfoundland (Div. 3K) and Labrador shelves (Div. 2J). Similarly, for Atlantic Wolffish, it appears that there are two distinct groups of fish: one centered on the southern Labrador shelf (Div. 2J), and another group centered in the southwest Grand Bank (Div. 3O). Atlantic Wolffish from Div. 3KLN and Subdiv. 3Ps are neither morphometrically nor meristically distinguishable from these other two groups of Atlantic Wolffish. This study provides potentially useful evidence for delineating the boundaries of different groups of Northern Wolffish and Atlantic Wolffish in Newfoundland and Labrador waters.

### **Discussion**

The accurate usage of the term "group" was discussed. It was suggested that there could be instances in which Wolffish tend to aggregate in particular areas and possibly could constitute a group of fish, and as such would alter the accuracy of using the term "group." It was clarified that the grouping as proposed in the study were based on morphometrics and meristics characteristics of Wolffish, which are in this case coincided with the spatial distribution of various groups of Wolffish.

It was concluded that the data presented are only part of what is used to determine groups and that there is currently not a clear idea of stock structure.

## **UPDATE OF THE PRE-COSEWIC REVIEW OF WOLFFISH IN THE MARITIMES REGION**

*Presenter: Jim Simon, DFO Science, Maritimes Region*

### **Abstract**

In 2010, DFO summarized the available RV and industry surveys and examined observer and commercial landings data for the three species of wolffish within the Maritimes Region. This document updates that information to 2012.

The summer RV survey continues to indicate that the abundance of both small (1-53 cm) and large (>53 cm) Atlantic Wolffish on the western Scotian Shelf (Div. 4X) is low with decline rates of 69 % and 83 %, respectively. Abundance of large Atlantic Wolffish continues to remain very

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low in the eastern Scotian Shelf (Div. 4VW). The abundance of small Atlantic Wolffish in Div. 4VW has generally increased over the series, but has been below average the last four years. The area occupied off the Scotian Shelf (Div. 4VWX), as indicated by the summer RV survey has exhibited a steady decline from a high of 58,000 km<sup>2</sup> in 1976 to a series low of 11,500 km<sup>2</sup> in 2012. There have been only two records on the northeast peak of Georges Bank since the last assessment confirming the very low abundance in this area.

The composite distribution pattern from all sources on the Scotian Shelf revealed that Northern and Spotted Wolffish are near the southern limits of their distribution and are restricted primarily to Div. 4V, with some fish found along the shelf edge in Div. 4WX. Overall abundance of both species in the RV surveys was very low occurring in less than 0.5 % of the sets. Industry surveys using longline gear on the eastern Scotian Shelf and in deeper strata had percent occurrences of both species between 1-7 % of the sets.

Although there are no directed fisheries for wolffish in the Maritime Region, the species is caught as a bycatch in other fisheries. Annual landings of wolffish by Canada in the Maritimes Region have continued to be less than 25 t since 2008.

Collectively the data suggests that there has been little change in the perception of the three species throughout the Maritimes Region since 2010, although the status of Atlantic Wolffish may be less positive.

## **Discussion**

There was a discussion about the types of substrate that occur where high concentrations of wolffish are found. It was noted wolffish were unexpectedly being found in areas with low relief and little structure. There were examples provided of surveys where wolffish were sampled in open areas, but structure was available nearby (e.g., ridges on German Bank, Southeast Shoal on Grand Bank). It was speculated that the observed concentrations of wolffish may be feeding aggregations that disperse to structured habitat (e.g., rocky outcrops) when not feeding. There was further discussion on the effect of sampling scale in relation to wolffish habitat associations. Fine scale surveys (e.g., scuba) show wolffish associated with structure while remotely operated vehicle (ROV) surveys show wolffish also occurring in open areas. Large-scale surveys, such as the RV trawl surveys, indicate wolffish associate with all available habitats; however, since trawls cover a large geographic area, it is unknown what microhabitats wolffish may be occupying when they are caught.

The relationship between the bottom type (i.e., boulder outcrops) and wolffish concentrations was considered interesting because if population structure is being assessed it would be more appropriate to examine the genetic structure of concentrations separated by some geographic distance or by unsuitable habitat

## **UPDATE FROM CENTRAL AND ARCTIC REGION**

*Presenter: Kevin Hedges, DFO Science, Central and Arctic Region*

### **Abstract**

There have been DFO RV surveys since approximately the year 2000 in Div. 0A and 0B. DFO RV trawls catch less than 10 wolffish per year. Canadian Fisheries Observer coverage of Div. 0A is approximately 10 %; 100 % coverage for Div. 0B. Northern and Spotted Wolffish commercial bycatch outside Canada's EEZ (in West Greenland waters) is retained and sold in Greenland (Nuuk). There is an active wolffish fishery in deeper West Greenland waters offshore (where it is warmer).



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## Discussion

It was stated that wolffish bycatch is actively sold in West Greenland and that catches increased during the 1990s. These increases occurred in warmer waters that are different than Div. 0AB. As such, the data available are oriented towards the West Greenland population rather than Canadian population due to NAFO reporting requirements for wolffish in West Greenland.

It was also stated that wolffish catches in Cumberland Sound were taken occasionally during the winter fishery and that there was low survival.

## POPULATION GENOMICS OF A "SPECIES AT RISK" PHYLOGEOGRAPHY OF ATLANTIC WOLFFISH

*Presenter: Steve Carr, Department of Biology, Memorial University of Newfoundland*

### Abstract

Abstract was not provided.

### Discussion

There does not seem to be much variability, particularly latitudinal, between populations. Looking at the tree of relationships, the fundamental method of analysis, there are individuals from northern areas (Div. 2J) and southern areas (Div. 3N) that are identical which suggests that there are migrant groups and genetic mixing is occurring. The analysis also suggests that the lineage originated in one area and moved out from there within the past 10,000 years or since the last ice age.

It was noted that there are different opinions in the literature regarding the diversity of wolffish populations. The differences are likely due to some researchers in the past looking at part of the genome, through the use of mitochondrial DNA or microsatellites, where fish may look identical, instead of the whole genome where fish may belong to completely different clades (e.g., Atlantic Cod). The genomic approach is revolutionary and is the preferred method.

## SURVIVAL OF ATLANTIC WOLFFISH (*ANARCHICHAS LUPUS*) CAPTURED INCIDENTALLY IN THE GRAND BANK YELLOWTAIL FLOUNDER (*PLEURONECTES FERRUGINEA*) OTTER TRAWL FISHERY

*Presenter: Scott Grant, Centre for Sustainable Aquatic Resources, Memorial University of Newfoundland*

### Abstract

In 2003, the Atlantic Wolffish (*Anarchichas lupus*), Spotted Wolffish (*A. minor*), and Northern Wolffish (*A. denticulatus*) were placed on Schedule 1 of SARA which afforded them protection against harm. Consequently, it is mandatory to release both Northern and Spotted Wolffish and it has been recommended that live-release protocols also apply to Atlantic Wolffish. Catches in trawls comprise a significant threat to recovery of all three wolffish species and the Grand Bank Yellowtail Flounder (*Pleuronectes ferruginea*) otter trawl fishery overlaps the most persistent high concentrations of Atlantic Wolffish in the Northwest Atlantic. As a result, the trawler fishery initiated a voluntary live-release program. The current study investigated the post-capture survival of Atlantic Wolffish captured incidentally in the Grand Bank Yellowtail Flounder otter trawl fishery. Survival was monitored for wolffish placed in holding tanks as well as wolffish returned to the ocean floor in cages. Results suggest the otter trawl fishery on the Grand Bank is unlikely to prevent the recovery of Atlantic Wolffish. This study demonstrated high (92-100 %)

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survival of Atlantic Wolffish captured in 2-2.5 hour commercial tows and following exposure to air for up to two hours when the ocean surface and bottom temperature difference was within 5.8 °C and air temperatures were <13 °C. These temperature conditions typically prevail for at least 70 % of the Yellowtail Flounder fishing season. Thus, the mortality risk to Atlantic Wolffish posed by the Grand Bank Yellowtail Flounder otter trawl fishery should be substantially reduced since the introduction of industries voluntary live-release program.

## **Discussion**

The total duration of the study was approximately two hours. The subsurface water onboard the holding tank was about 1-1.5 °C (about 4 °C warmer than the bottom temperature). It was noted that the holding tanks were cooler than 1-1.5 °C. During the washing of the species in the cold, moist air, the wolffish seemed to shut down and conserve energy. They experienced decreased operculum beats, and the strong were noted to push their way to the top of the catch. The holding tanks were constantly flushed and were not originally oxygenated. The holding tanks were also flushed with surface water in both the spring and autumn. It was also noted that the wolffish are highly resilient to oxygen depletion unlike a cod, which does not sit on the ocean bottom and has to swim.

## **UPDATE OF WOLFFISH SURVEY VESSEL QUEBEC REGION**

*Presenter: Denis Chabot, DFO Science, Quebec Region*

### **Abstract**

Data from RV surveys conducted in the Gulf of St. Lawrence (GSL) are available for the period 2009-12 for the first time. This update only concerns RV surveys since the sentinel surveys have not been updated. Abundance data are available for the 1990–2012 periods in the northern GSL (NGSL) and for 1970–2012 for the southern GSL (SGSL). Frequency of occurrence is available for 1978–2012 for the NGSL only. Northern Wolffish is not encountered in the SGSL, and is only rarely seen in the NGSL, although it occurred more often in the survey prior to 1990. There is no conversion factor for the combination of ships and gears used before and after 1990. Spotted Wolffish is also absent from the surveys conducted in the SGSL. Its abundance was very low in the NGSL during 1990–97, and has increased afterward, to stabilise at ~0.2 kg per tow in recent years. Similar trends are apparent with frequencies of occurrence, but the longer time series suggest similar levels during 1978–89 and 2003–12. Atlantic Wolffish is present in the SGSL surveys, its abundance oscillating around a mean of about 0.025 fish per tow during 1970–2012, except for the period 1988–92, when it was a bit more abundant. In the NGSL, Atlantic Wolffish abundance has been fluctuating without trend during 1990–2012. Frequencies of occurrence were around 15–20 % during most of the 1978–2012 periods, with lower occurrences being observed from 1990 to 1998.

### **Discussion**

There was discussion about the vessels and the types of gears used during the early part of the time series. There was further discussion on the timing of the trawl surveys. It was noted that some gears do not have conversion factors, and also that particular areas were not surveyed due to ice coverage. It was suggested that another summer survey, which covered the entire Gulf, using scallop gear may be part of the time series data but no conversion factors exist between the series.

## **IMPACT OF HYPOXIA ON SPOTTED WOLFFISH**

*Presenter: Denis Chabot, DFO Science, Quebec Region*

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## Abstract

Experimental work on juvenile Spotted Wolffish (150 g) demonstrates that growth rate becomes proportional to the level of dissolved oxygen (DO) when DO falls below 70 %. Decreased growth rate in hypoxia (low DO) was accompanied by reduced food consumption, likely the result of the lower amplitude and longer duration of the specific dynamic action, i.e., the increase in oxygen consumption taking place during digestion. Hypoxia tolerance of Spotted Wolffish, as measured by the critical oxygen level (DO level at which the fish cannot sustain its standard metabolic rate) was 17 % saturation for 2 kg adults, and ~30 % saturation for 0.8 kg juveniles. In the GSL, the deep channels (> 175 m) are hypoxic, with DO < 50 % saturation, and levels in the range 20–30 % saturation at the head of the channels, including the head of the Esquiman channel. The Spotted Wolffish partially avoids hypoxic water, as demonstrated by a very different depth distribution in the GSL compared with the waters east of Newfoundland. Even so, some wolffish of all three species do face DO levels below 50 % saturation in the GSL. The growth potential of these fish should be lower than for fish in normoxic water, but there are presently no data on growth rate of wild Spotted Wolffish living at different DO levels. The impacts of DO on gonad maturation, fertility, and egg development have not been studied.

## Discussion

The fish were force-fed the same amount as the control feeding rate (under hypoxic conditions fish took longer to digest their meal). The state of reduced growth in the wolffish concentrations is unknown. It was suggested that wolffish pockets may have been missed during the surveys.

## DISCUSSION DURING THE SAR REVIEW

There was discussion on the validity of reviewing the “status” of wolffish presently at the meeting.

There was some discussion on text within the document and also on how to include new information. It was suggested to remove the background biological information and instead discuss the new data acquired since the Simpson et al. 2012, Simon et al. 2012, and Dutil et al. 2011 documents. It was concluded to apply the objectives of the Recovery Strategy to the research that has been conducted. There was also discussion of editing the trawl data section (i.e., leave in background, graphs, just have graphs, etc.). It was suggested to remove the distribution maps as the distribution has not changed and the maps will be in other documents. Participants discussed the standardization of figure formatting. Participants also spoke about how to present the trend data considering how some regions have analyzed length data to distinguish mature vs. immature individuals.

There was a debate over whether to discuss how morphometric data feeds into the designatable unit (DU) designation of these species within the morphometric/meristic paragraph.

Finally, there was discussion about the data obtained from the NAFO database. There were some questions surrounding the validity of particular data points. There was discussion on the validity of the live discard data. There was debate on what should be included in the sources of uncertainty (i.e. how this will help meet the objectives of the 5-year plan evaluation). Discussion of sentences to use as summary bullets also occurred. There was a discussion of how the process is too closely related to an assessment meeting in which science information is provided for stock assessment. Participants displayed a desire for a chance to innovate in development of this new process.



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## REFERENCES CITED

- DFO. 2011. Zonal Advisory Process for the pre-COSEWIC assessment of Atlantic, Northern and Spotted Wolffish; September 14-15, 2010. DFO Can. Sci. Advis. Sec. Proceed. Ser. 2011/032. (Errata: October 2012).
- Dutil, J.-D., Proulx, S., Hurtubise, S., and Gauthier, J. 2011. Recent findings on the life history and catches of wolffish (*Anarhichas* sp.) in research surveys and in the Sentinel Fisheries and Observer Program for the Estuary and Gulf of St-Lawrence. DFO Can. Sci. Advis. Sec. Res. Doc. 2010/126. x + 71 p.
- Kulka, D., Hood, C., and Huntington, J. 2007. Recovery Strategy for Northern Wolffish (*Anarhichas denticulatus*) and Spotted Wolffish (*Anarhichas minor*), and Management Plan for Atlantic Wolffish (*Anarhichas lupus*) in Canada. Fisheries and Oceans Canada: Newfoundland and Labrador Region. St. John's, NL. x + 103 p.
- Simon, J., Rowe, S., and Cook, A. 2012. Pre-COSEWIC review of Atlantic Wolffish (*Anarhichas lupus*), Northern Wolffish (*A. denticulatus*), and Spotted Wolffish (*A. minor*) in the Maritimes Region. DFO Can. Sci. Advis. Sec. Res. Doc. 2011/088. vi + 73 p.
- Simpson, M.R., Mello, L.G.S., Miri, C.M., and Treble, M. 2012. A pre-COSEWIC assessment of three species of wolffish (*Anarhichas denticulatus*, *A. minor*, and *A. lupus*) in Canadian waters of the Northwest Atlantic Ocean. DFO Can. Sci. Advis. Sec. Res. Doc. 2011/122. iv + 69 p.

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## APPENDIX 1: TERMS OF REFERENCE

A current assessment of Northern, Spotted, and Atlantic Wolffish related to population status, life history, and habitat

Zonal Advisory Process - Newfoundland and Labrador, Maritimes, Gulf, Quebec, and Central and Arctic regions

January 23-24, 2013

St. John's NL

Chairperson: Geoff Veinott

### Context

The Recovery Strategy for Northern Wolffish (*Anarhichas denticulatus*) and Spotted Wolffish (*Anarhichas minor*), and Management Plan for Atlantic Wolffish (*Anarhichas lupus*) in Canada (Kulka et al. 2007) was published on the *Species at Risk Act* (SARA) public registry in February 2008. The SARA s.46 states that "*the competent Minister must report on the implementation of the recovery strategy and the progress towards meeting its objectives, within five years after it is included in the public registry and in every subsequent five-year period, until its objectives have been achieved or the species' recovery is no longer feasible. The report must be included in the public registry.*" Similarly, s.72 of the Act states that "*the competent Minister must monitor the implementation of the management plan and must assess its implementation five years after the plan is included in the public registry, and in every subsequent five-year period, until its objectives have been achieved. The report must be included in the public registry.*" The Newfoundland and Labrador Region Species at Risk Program is now responsible for delivery of the five-year report in February 2013. In September 2010, a zonal pre-COSEWIC assessment of Atlantic, Northern, and Spotted Wolffish was held to peer-review Fisheries and Oceans Canada (DFO) information relevant to the COSEWIC status assessment for the three wolffish species in Canadian waters (DFO 2011). Four DFO Canadian Science Advisory Secretariat (CSAS) research documents were generated as a result of the assessment (see References). The current Zonal Advisory Process (ZAP) will provide an update on wolffish life history, population status, and habitat requirements summarizing research completed and data collected from September 2010 to present. This information will be used to develop the five-year report (2008-13) on recovery progress and implementation report for Northern Wolffish and Spotted Wolffish.

### Objectives

The overall objective of this meeting is to provide an update on the status of Northern, Spotted and Atlantic Wolffish since September 2010. This information is needed to report on implementation of the Recovery Strategy and progress toward meeting its objectives for the Northern and Spotted Wolffish and assess the implementation of the Management Plan for the Atlantic Wolffish. In addition, reporting is required for a number of activities included in the draft Action Plan for Northern and Spotted Wolffish. Where data are available, and to the extent possible, information relevant to the following will be reviewed:

- population structure and life history;
- spatial and temporal abundance patterns;
- spatial and temporal mortality (natural, human induced) patterns;
- impacts of human activity identification and mitigation;
- ecosystem interactions;

- biological reference points; and,
- habitat identification and conservation.

### **Expected Publications**

- Science Advisory Report
- Proceedings
- Research Document(s)

### **Participation**

- Fisheries and Oceans Canada (DFO) Science, Fisheries and Aquaculture Management, and Species at Risk
- Provincial Government Departments
- Industry
- Academia
- Aboriginal communities/organizations
- Other invited experts

### **References**

- DFO. 2011. Zonal Advisory Process for the pre-COSEWIC assessment of Atlantic, Northern and Spotted wolffish; September 14-15, 2010. DFO Can. Sci. Advis. Sec. Proceed. Ser. 2011/032. (Errata: October 2012).
- Kulka, D., Hood, C., and Huntington, J. 2007. Recovery Strategy for Northern Wolffish (*Anarhichas denticulatus*) and Spotted Wolffish (*Anarhichas minor*), and Management Plan for Atlantic Wolffish (*Anarhichas lupus*) in Canada. Fisheries and Oceans Canada: Newfoundland and Labrador Region. St. John's, NL. x + 103 p.



## APPENDIX 2: MEETING AGENDA

Meeting of the Zonal Advisory Process (ZAP) on a current assessment of Northern, Spotted, and Atlantic Wolffish related to population status, life history, and habitat  
 Holiday Inn, Portugal Cove Road  
 St. John's, Newfoundland & Labrador  
 January 23-24, 2013

AGENDA		
Wednesday, Jan. 23rd		
09:00-09:15	Participant arrival and setup	ALL
09:30-10:00	Update of survey vessel data	Mark Simpson
10:00-10:30	Feeding habits and trophic niche differentiation in three species of wolffish ( <i>Anarhichas</i> sp.) inhabiting Newfoundland and Labrador waters	Luiz Mello
10:30-10:45	Coffee Break	
10:45-11:00	Commercial catch data	Carolyn Miri
11:00-11:30	Morphometric and meristics variability of wolffish ( <i>Anarhichas</i> sp.) in Newfoundland and Labrador waters.	Luiz Mello
12:00-13:00	Lunch (Not Provided)	
13:00-13:30	Update from Central and Arctic Region	Kevin Hedges
13:30-14:00	Population Genomics of a "Species At Risk": phylogeography of Atlantic Wolffish	Steve Carr
14:00-15:00	Open Discussion – Terms of Reference, Research Recommendations, Review of Science Advisory Report (SAR)	ALL
15:00-15:15	Coffee Break	
15:15-16:30	Continued Review of SAR	ALL
16:30	Adjourn	
Thursday Jan. 24th		
09:00-09:15	Participant arrival and setup	ALL
09:15-10:30	Continued Review of SAR	ALL
10:30-10:45	Coffee Break	
10:45-12:00	Continued Review of SAR	ALL

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AGENDA		
12:00-13:00	Lunch (Not Provided)	
13:00-15:00	Continued Review of SAR.	ALL
15:00-15:15	Coffee Break	
15:15-16:30	Completion of SAR	ALL
16:30	Adjourn	

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